Review Article

My Approach to Assess Diastolic Function in the Presence of Atrial Fibrillation?

Como eu Faço a Análise da Função Diastólica na Presença de Fibrilação Atrial

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Introduction

Atrial fibrillation (AF) is a prevalent arrhythmia that can occur alone or in combination with other clinical conditions. Its onset interferes both in common diagnostic algorithms and in their respective protocol procedures. In diastolic function assessments by echocardiography, it drastically changes the analysis sequence.[1] This relationship becomes even more complex because diastolic dysfunction is onc cause of non-valvular AF.[2]

A group of conditions called "special populations" or "situations" in diastology also modify study algorithms, especially but not exclusively sinus tachycardia, hypertrophic cardiomyopathy, restrictive cardiomyopathy, non-cardiac pulmonary hypertension, mitral stenosis, mitral regurgitation, greater than mild mitral annulus calcification, heart transplantation, and constrictive pericarditis.[3–12]

Special populations are so important in diastology that the presence of these conditions must be ruled out before any analysis may be performed and the common algorithm can be applied. Therefore, despite being groups of different clinical conditions that can be wrongly relegated to a category of secondary importance and seemingly underrepresented in guidelines and reviews, knowing them is essential to a reliable and comprehensive diastolic function assessment.

Determination and graduation of diastolic dysfunction with af

Chronic atrial fibrillation (CAF) is the most prominent of these special situations due to both its high prevalence and the correlation of AF with the same etiologies classically associated with diastolic dysfunction.[13] For this reason, the presence of CAF is indicative of diastolic dysfunction in the same way as when determining myocardial disease (e.g., left ventricular ejection fraction < 50%, left ventricular hypertrophy, changes in myocardial segmental contractility, and signs of longitudinal systolic dysfunction).[1] Despite not being explicitly stated in current guidelines, reviews on the subject, or original articles, FAC represents a diseased heart for which this rationale makes sense.

In the presence of sinus rhythm without other special situations, diastolic dysfunction is classified into three categories: grade I, normal filling pressure; grade II, increased filling pressure; and grade III, increased filling pressure and filling restriction signs. This restrictive pattern (grade III) is defined as left ventricular (LV) filling restrictions during atrial contraction, translated by a relatively small A wave measured by transmitral Doppler, which obviously ceases to occur as a result of AF. For this reason, diastolic dysfunction grading in the presence of AF is limited to the first two categories (Figure 1).

Assessment sequence

Several echocardiographic variables indicate increased filling pressures in the presence of AF. However, the cutoff values used in these determinants do not always correspond to the same values used in sinus rhythm.

The first rule for determining filling pressures in the presence of CAF is not to use atrial dimensions, i.e., regardless of measurement type, volume, or anteroposterior dimension, indexed or not, its increase does not correlate with increased filling pressures. This is due to the well-known mechanical remodeling induced by AF, which increases atrial dimensions regardless of the filling pressure.[13]

The second rule is to start by measuring the maximum tricuspid regurgitation jet velocity, a good determinant of the filling pressure increase when ≥2.8 m/s (the same cutoff line recommended for the study in sinus rhythm). However, this measure cannot be used in two situations: the absence of a measurable jet; and the presence of concomitant diseases affecting the pulmonary vascular resistance, such as primary arterial hypertension, chronic obstructive pulmonary disease, and pulmonary thromboembolism.

Even respecting these two rules, the data will be insufficient, as it is recommended to use more than one determinant. Therefore, other Doppler variables well studied in this scenario and with good accuracy are used, each with its own limitation (Table 1).

The first choice is to measure the mitral inflow E-wave deceleration time (DT) by pulsed Doppler for being an easy and highly accurate measurement. However, this is only valid for subjects with reduced left ventricular ejection fraction (LVEF) (<50%), as E-wave DT is not a good determinant of filling pressure increase in subjects with preserved LVEF.[14,15]

Keywords

Echocardiography; Diastole; Atrial fibrillation.

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Manuscript received 6/24/2022; revised 7/11/2022; accepted 8/9/2022
Editor responsible for the review: Daniela do Carmo Rassi Frota

DOI: 10.47593/2675-312X/20223504eabc344i

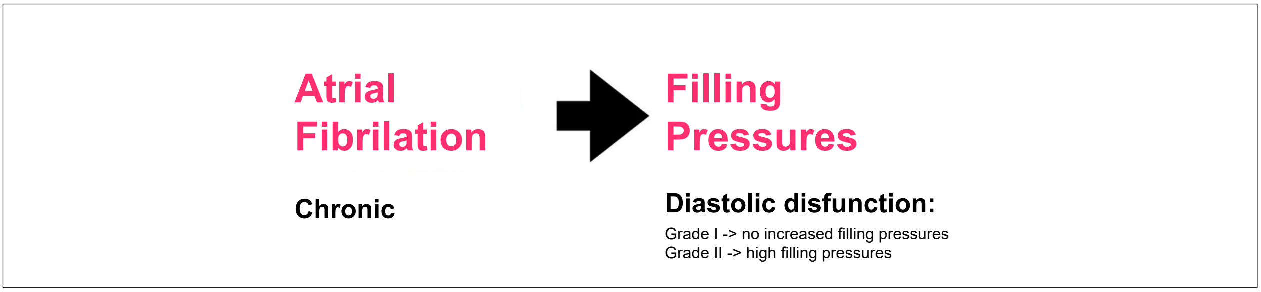

Figure 1 – *Graduation of diastolic dysfunction in atrial fibrillation.*

Tabela 1 – Variáveis complementares para diastologia em casos de fibrilação atrial.

Variável	Correlação	Sensibilidade (%)	Especificidade(%)	Autores
E/e' septal	0,79	75	93	Sohn DW et al (1999) [16]
TD onda E mitral	-0,95	100	96	Temporelli PL et al (1999) [14]
TD onda D pulmonar	-0,91	100	100	Chirillo F et al (1997) [17]
Pico de aceleração da onda E mitral	0,84	77	94	Nagueh SF et al (1996) [15]
TRIV	-0,76	72	88	Nagueh SF et al (1996) [15]
E/VPF	0,88	72	100	Nagueh SF et al (1996) [15]
TD onda E mitral (FEVE <45%)	-0,78	76	100	Nagueh SF et al (1996) [15]

E = pico de velocidade da onda E do fluxo transmitral, e' = pico de velocidade da onda e' do anel mitral, FEVE = Fração de ejeção do ventrículo esquerdo, TRIV = tempo de relaxamento isovolumétrico, TD = tempo de desaceleração, VPF = velocidade de propagação de fluxo

Therefore, in cases with reduced LVEF, an E-wave DT ≤ 160 ms indicates high filling pressure.[1]

A set of variables can be used in cases with preserved LVEF:

- Peak E-wave acceleration rate (PEAR) - cutoff value ≥ 1,900 cm/s^2
- Isovolumetric relaxation time (IVRT) - cutoff value ≤ 65 ms
- Pulmonary venous diastolic velocity DT - cutoff value ≤ 220 ms
- Peak E-wave velocity/LV flow propagation velocity ratio (E/FPV) - cutoff value ≥ 1.4
- Septal E/e′ ratio - cutoff ≥ 11

All measurements have good accuracy; thus, choosing which one to use depends on other characteristics, such as tool availability in the software (PEAR), which may not be available on the equipment used. In addition, reproducibility issues should also be considered, such as variables using pulmonary venous flow pulsed Doppler and flow propagation velocity, which are particularly limited in this regard. Therefore, IVRT and septal E/e′ ratio continue to be strongly recommended, the first for being simple and practical and the second for being commonly used in basic protocols.

Regardless of the method chosen, the standard recommendation is to measure 10 consecutive cardiac cycles, but this extends the testing time. Alternatively, three non-consecutive cycles can be evaluated, provided that their rate is 10–20% of the mean heart rate.[1,15]

A last and simple resource to complement the assessment of filling pressures in patients with CAF is the variable maximum mitral inflow velocity between beats (E-wave), a consequence of typical rhythm irregularity in AF. This variability is reduced in patients with increased filling pressures, making it a possible determinant, although it is qualitative (Figure 2).[15] However, as it has no cutoff value or any form of quantification, this type of evaluation is subjective, which justifies its use as a last option.

Finally, the resources presented here can be listed as a logical four-step sequence (Figure 3). This proposition corroborates the 2016 guidelines of the American Society of Echocardiography and the European Society of Cardiovascular Imaging for the assessment of diastolic function, and it respects the balance between assessment accuracy, practicality, and availability. It is important to note that, regardless of the variable chosen and/or available at each stage, the use of more than one determinant is recommended.[1]

Final considerations

Although the concepts chosen to justify our assessment of diastolic function are quite clear, some points are debatable, as is the case of attributing the presence of diastolic dysfunction to the mere occurrence of AF, a flawed concept not explicitly clear in the literature. However, considering these logical aspects, it makes no sense to grade diastolic dysfunction in the absence of a diagnosis. Therefore, while there is no more specific proposal in this regard, this is the recommended rationale.

The assessment described here is aimed at non-valvular CAF, i.e., in case of significant mitral valve diseases or other conditions, the physician should use specific algorithms and common sense.

New technologies were not mentioned, as they are not the purpose of this article, which focused on what we actually use in current practice. Some technologies can help and considerably

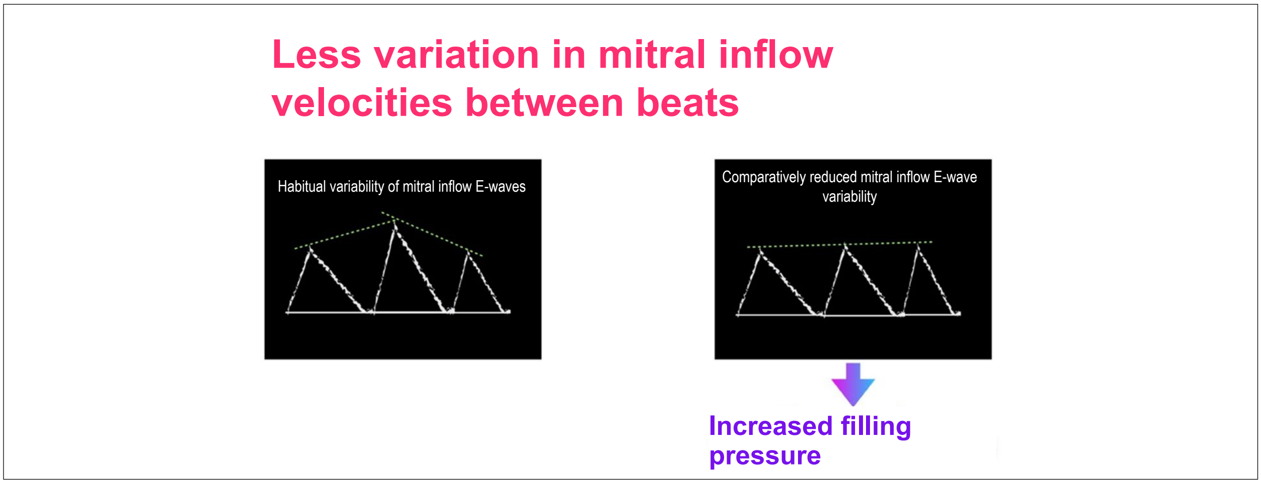

Figure 2 – *Qualitative assessment of E-wave variability in atrial fibrillation.*

Determinants of increased filling pressures in cases of atrial fibrillation

1. RT velocity
2. E-wave DT (decreased left ventricular ejection fraction)
3. Other Doppler variables (isovolumetric relaxation time)
4. Decreased E-wave variation (qualitative)

Use more than one determinant

Figure 3 – *Sequence for assessing diastolic dysfunction in atrial fibrillation.*

simplify the assessment of diastolic function in patients with AF, such as special transducers capable of simultaneously recording mitral annulus and transmitral flow tissue Doppler.[18-20] However, such tools are not used in current practice.

Authors' contributions

Manuscript Writing: Calvilho Júnior AA and Assef JE: Bibliographic Research, review of the Manuscript and intellectual concept of its structure: Braga JMS and Vilela AA.

Conflict of interest

The authors have declared that they have no conflict of interest.

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